CRIMESCOPE® CS-16

TUNABLE FORENSIC LIGHT SOURCE
OPERATION & MAINTENANCE INSTRUCTIONS

APPLICATION MANUAL

Part Number 81045

SPEX FORENSICS

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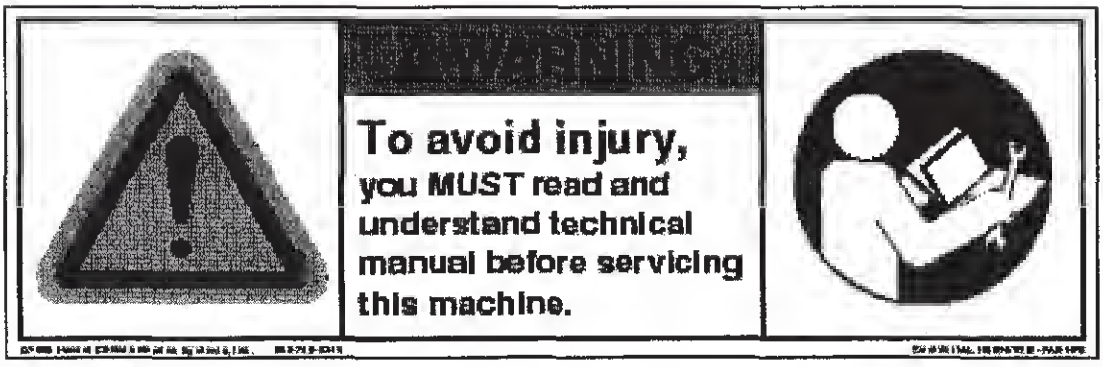
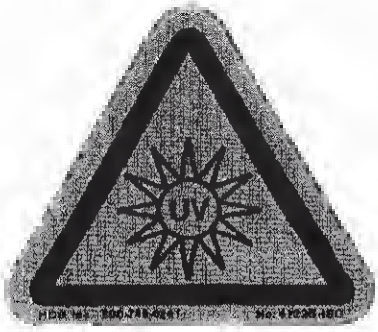
CAUTION !


WARNING
To avoid injury,
you MUST read and
understand technical
manual before servicing
this machine.

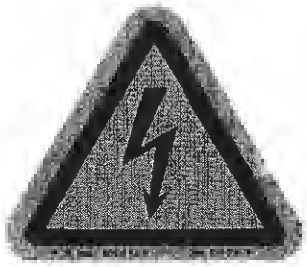


ULTRAVIOLET LIGHT !
WEAR PROTECTIVE GOGGLES
DO NOT STARE INTO BEAM

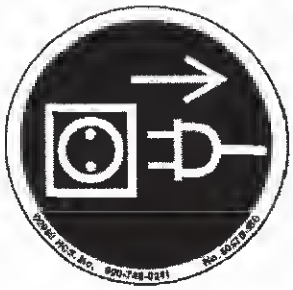
HIGH PRESSURE BULB
RISK OF EXPLOSION !
DO NOT DROP !

DO NOT EXPOSE INSTRUMENT TO
WATER OR HUMIDITY !

BURN HAZARD !
ALWAYS LET UNIT COOL DOWN BEFORE SERVICING



HIGH VOLTAGE
RISK OF ELECTRICAL SHOCK !



DISCONNECT POWER BEFORE OPENING UNIT

READ MANUAL BEFORE USING OR SERVICING INSTRUMENT !

CONTENTS

1. WHEN THE CRIMESCOPE ARRIVES

1.1 Unpacking and Checking

Examine the shipping box for damage. Any evidence of such should be noted on the delivery receipt which should be signed by representatives of the addressee and carrier.

Unpack your CrimeScope and inspect it for damage. Notify your carrier and SPEX immediately if any is found. The packing material should be saved for future use or for inspection by the carrier should the instrument be damaged.

1.2 CrimeScope CS-16 Components

The CrimeScope system should include the following components :

- CrimeScope Main Unit
- 3 plugs mounted on the front port and on the 2 lateral ports and held by 3 thumbscrews.
- Carrying Bag for CrimeScope + Luggage Cart
- Case for accessories (The initial briefcase has been replaced with a larger case which can accommodate the BIB-150).
- Two meters light guide (metallic shielding)
- Black collimator mounted on above guide
- Heavy duty flexible arm with clip clamp (holds remote control or black light handle) and superclamp (attaches to table or tripod) REPLACES discontinued red stand (Vee Lab Base/20"rod/clamp)
- Power Cord (110V or 220V connector) (3 meters)
- 2 pairs of orange goggles, 1 of red ones, 1 of yellow ones and 1 of UV protective goggles.
- 4 barrier camera filters (62mm diameter) : 2 orange ones #21, 1 red #23A and 1 custom red bandpass filter (600 nm with 35nm width)
- 1 meter fiber optic (8 mm diameter for infrared port)
- 4 IR filters and holder (630-715-780-830) with thumbscrew. (The 630 is permanently mounted in the IR fiber optic holder)
- CrimeScope Manual
- Thermal Compound (white paste in small plastic container ; to change bulb)

Additional Components :

Optional hand-held (black) remote push-button controller with cable attached to liquid light guide and thumbscrew.

Inspect every component for damage. Check that the SLIDE for the lateral UV port operates correctly. (This push-pull slide is located BELOW the port with the 2 plugs).

2 SETTING-UP THE CRIMESCOPE

2.1 Electrical and optical connections

Check that the 2 switches (fans and lamp) are on the "OFF" position.
Check that the "UV" slide below the (2) plugs on the side port is pushed in. Set wheel 2 to one of the two "MAX POWER" positions.

Connect the power cord to the CrimeScope and the (110V or 220V) outlet.
Connect the Liquid light guide to the output port on the front panel.
Secure with the thumbscrew once the guide is pushed all the way in.
Connect the Remote Controller (Option) on the front panel and verify the connection on the controller itself.

Do not block intake/exhaust fans. Overheating reduces the life time of the bulb and power supply. (The lateral fan is a DC fan and will not hurt you if you touch it.)
Do not aim the light guide at anybody's face. (You may attach it to the clip clamp mounted at the end of the flexible arm).

2.2 Getting started

1/ TURN THE FANS ON.

WARNING : If the unit has been stored in a very cold area (around or below 0 C / 32 F) [for example in the trunk of a car in the winter time], leave the fans on for 5-10 min before turning the lamp on. This procedure will allow the lamp AND the filters to warm-up and reach the room temperature.

2/ TURN THE LAMP ON.

The lamp will ignite within 1-3 seconds. If clicks are heard, wait 5-6 seconds. If the lamp doesn't ignite, turn-off the lamp and fans.
Try again after 30 sec. FANS on first, then the LAMP.
If a few attempts are unsuccessful and you've checked the fuse next to the power switch, contact SPEX / Service Dept.

As soon as the lamp is on, the unit will autocalibrate itself by rotating wheel 1 until it finds CSS (Crime Scene Search filter).
You should now see a bright blue spot.

If no light is seen but the display shows "CSS", try turning wheel 2 one way or another : you might be on a shutter position next to the "MAX POWER" positions.
If there is no display but the lamp is on or if the display shows "ERR", turn everything off and try again after 30 sec.
If two attempts aren't successful, contact our Service Dept.

3/ WARNING : The recommended procedure to turn the system off is to turn the lamp off first and leave the fans on for 3-5 min to allow for the xenon bulb to cool down. This will increase the life time and power output. This is not an absolute requirement. If you're in a hurry at the crime scene, you don't have to cool down each time the lamp is turned off.
The effect on the life time can only be estimated : by allowing the bulb to cool down nearly each time you shut down the unit may increase the life time from 1200 hours to 1400-1600 hrs and the power output of the bulb by 5-8 %.

3 SPECIFICATIONS & FUNCTIONS

The CrimeScope CS-16 is a complete system for fluorescence examination. It is rugged and may be used in the Lab as well as at the Crime Scene.

3.1 Wheel 1

Wheel 1 is automated and controlled from push-buttons (UP/DOWN) located on the front panel of the instrument or from the optional hand-held controller.

The wheel has 15 positions (14 with bandpass filters) and one for white light. (The two other bandpass filters of the CS-16 are on the UV side port and on the portable BIB-150 UV lamp).

The center wavelength is indicated on the top digital display. The fine tune shift (negative) is indicated on the lower display. It allows you to record the exact conditions of a photography set-up. (Record the wavelength and the shift OR just the difference : For example : [530 nm - 10 nm] OR [520 nm].

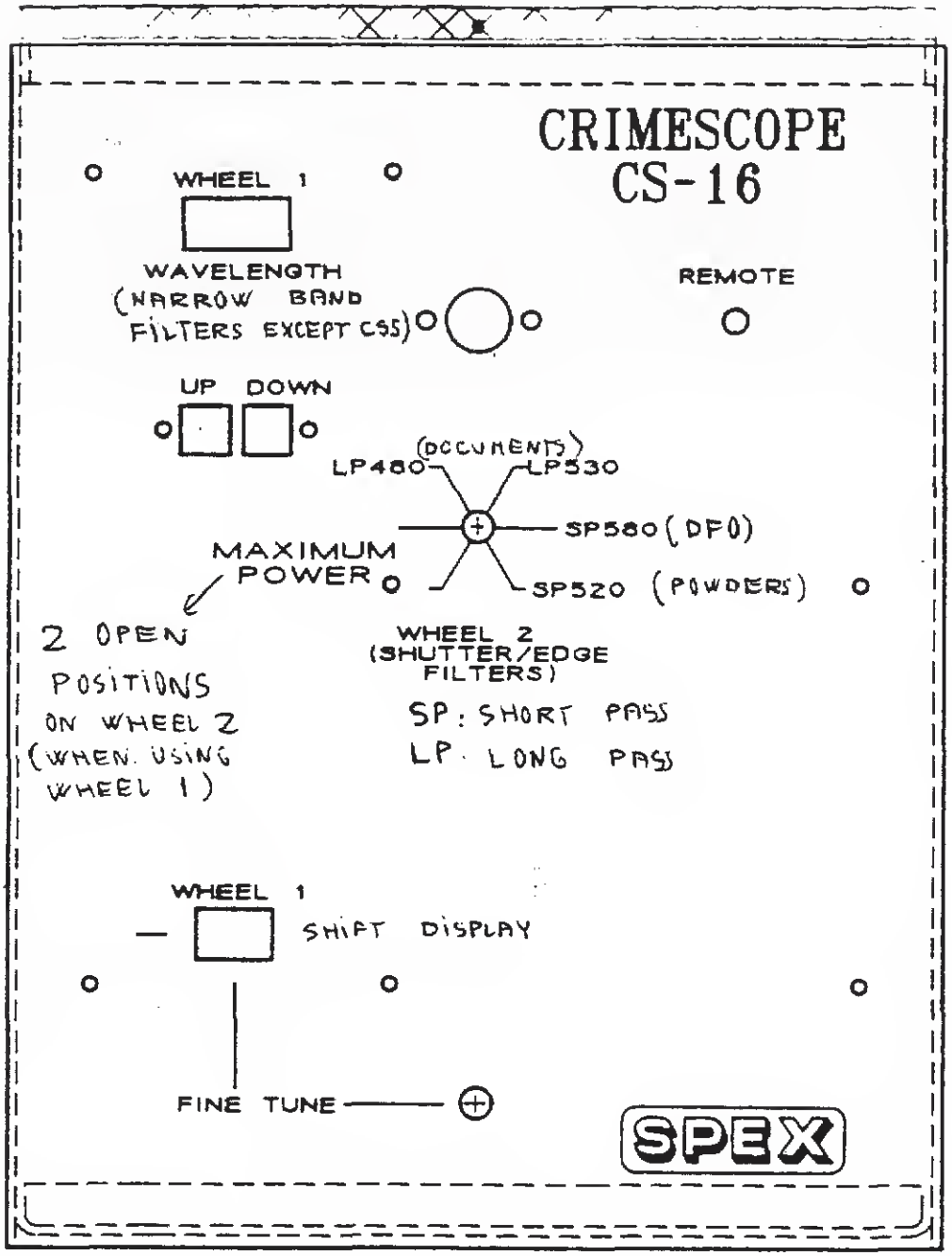
VALUES (and corresponding nominal bandpasses +/-5 nm at 50%) :

"000"	WHITE LIGHT (when wheel 2 is in "MAX POWER" position)
"415"	45 nm
"430"	45 nm
"445"	40 nm
"455"	70 nm (Broad but no UV / no Green)
"475"	45 nm
"495"	45 nm
"CSS"	130 nm (near UV-Violet-Blue-Green SIMULTANEOUS for SEARCH mode)
"515"	30 nm
"530"	40 nm
"555"	30 nm
"575"	See SP580 low pass filter
"600"	50 nm
"640"	50 nm
"675"	50 nm

The SP580 is now installed on wheel 1 (common filter for DFO) and the 575BP50 is installed on wheel 2 in "SP580" position - Effective Jan95) Several filters have very narrow bands so that you can excite a print at a wavelength very close to the "Cut-on" value of the selected barrier filter (For example : 515-30 is compatible with orange goggles and 555-30 is compatible with red goggles).

When you turn the lamp on, CSS is the default value (after the autocalibration).

To view fluorescent latent prints, operate in a dark room.



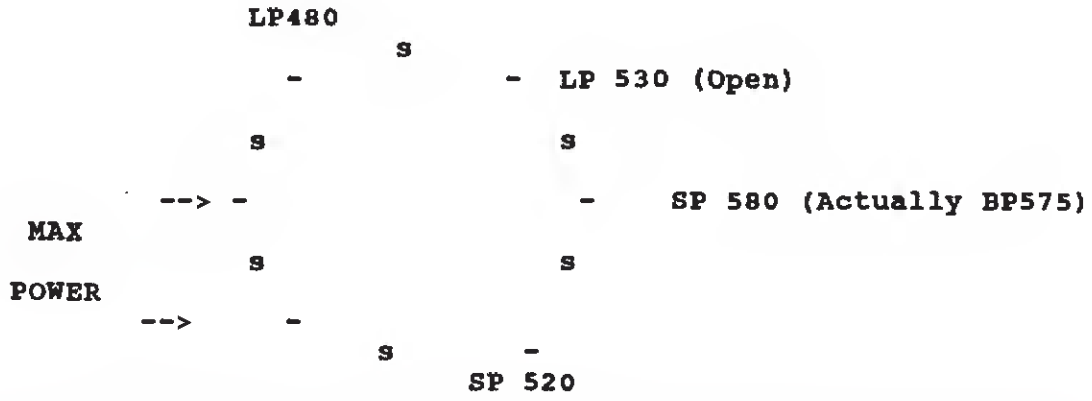
- SET WHEEL 1 TO "000" (OPEN POSITION) WHEN YOU WISH TO USE WHEEL 2.

- TO COMBINE FILTERS FROM WHEEL 1 WITH WHEEL 2, SEE APPENDIX.

3.2 Wheel 2

Wheel 2 is manual and controlled from the manual knob on the front panel. If you have no experience with fluorescence and document examination we suggest you familiarize yourself with these techniques for a few weeks by just using the wheel 1 : leave the wheel 2 in the "MAXIMUM POWER" positions and just use it to adjust the intensity if required.
You may just evaluate the SP580 filter with weak DFO prints (+red goggles).

Wheel 2 has 12 positions :



The "s" positions between the labelled positions are Shutter positions. (No need to turn the lamp off when you temporarily need to block the light output.) (Rotating towards an "s" position will adjust your intensity).

There are 2 "MAX POWER" positions. (One of these or the "s" positions could be used in the future for upgrades with very specific filters required by new dyes (special edge filters or ultra-narrow band (10-15nm) filters.)

SP-520 : Shortpass filter (Transmits all the wavelengths below the cut-off value 520 nm [specified at 1%]).
TRANSMITS NUV-VIOLET-BLUE
BLOCKS GREEN-YELLOW-ORANGE-RED

SP-580 : Shortpass filter (Transmits all the wavelengths below the cut-off value 580 nm [specified at 1%]).
TRANSMITS NUV-VIOLET-BLUE-GREEN-YELLOW
BLOCKS RED

LP-480 : Longpass filter (Transmits all the wavelengths above the cut-on value 480 nm [specified at 1%]).
TRANSMITS GREEN-YELLOW-ORANGE-RED (LOOKS YELLOW)
BLOCKS UV-VIOLET-BLUE

RULES FOR THE TWO WHEELS :

1/ When you only want to use wheel 1 (Bandpass Filters),
set wheel 2 to one of two "MAX POWER" positions
(You may then use wheel 2 to adjust the intensity by
rotating it towards a shutter position).

2/ When you only want to use wheel 2 (Edge Shortpass/Longpass Filters)
set wheel 1 to "000" position.

3/ To use both wheels, combine a broad bandpass filter (for example :
"CSS" or 575) with an edge filter (for example : "LP-480")

Example 1 : _ To get white light, set wheel 1 to "000"
and wheel 2 to "MAX POWER"

Example 2 : _ Combining filters from the two wheels :
Looking at a latent print on painted or luminescent
plastic treated with Rhodamine (or RAM / RAY ...)

Use CSS + MAX POWER position (+ orange goggles)
You will see the print excited with UV-VIOLET-BLUE-GREEN
The luminescence of the background affects the contrast.
The background (plastic) is usually excited by UV-VIOLET ;

Setting wheel 2 to "LP-480" will eliminate these low
wavelengths and improve the contrast (less "blur").

For more examples, see appendix C.

3.3 Lateral Output

The two ports on the side are for Ultraviolet and Infrared illuminations.

a/ The Infrared beam (630-1100 nm) is always present (just remove the plug). Connect the one meter fiber optic bundle (8 mm diameter).
You don't have to push the fiber all the way in unless you need maximum power. Sliding the fiber in and out adjusts the power. To avoid overheating don't leave the fiber pushed all the way in for more than 30 min.
_ONLY CONNECT THE IR FIBER WHEN USING IT.

CAUTION : _ Do not aim the fiber at paper or other substances that may ignite with heat (Example : do not expose your clothes to a concentrated IR beam)
_ Infrared radiations (above 700 nm) are invisible. (It just feels like heat)
_ Do not try to use the liquid light guide with the Infrared Output : it doesn't transmit IR but absorbs it and would be destroyed.
_ Leave the Plug on when you don't use this output. Caution : the plug might be hot.

The Infrared is used for document examination.

b/ The UV output (280-380 nm) is selected with the slide located below the two ports and is recommended for photography with concentrated UV illumination.
Slide pushed-in : UV OFF
Slide pulled-out : UV ON (Wear UV spectacles)
Turn the UV off when using the front visible output to ensure maximum visible power.

Stacking two filters of the same color usually improves your contrast.

If you wish to permanently couple the orange filters, you may mount the two filters in one mount (release the internal ring to get the filters out ; make sure you clean the filters with lens paper before you stack them in a single ring). A third orange filter may be used in case of strongly reflective surface. (Tiffen or Nikon orange filters may be ordered in camera stores).

The red filter # 23A and red bandpass filter (600/35) are mostly recommended for DFO work. Do not always trust your camera meter : you may overexpose.
The orange filters used with CSS excitation may also give good results.

3.7 Remote hand-held controller

This optional controller holds the light guide and allows you to change the center wavelength with the push-button.
The controller cable may be disconnected/connected anytime to the front panel (even if the instrument is ON).

Use the thumb-screw to release the light guide. To disassemble them, an alen key will be required to disconnect the collimator.

3.8 Optional Kit of camera filter filters

3.8.1 CS-FILT

The CS-FILT kit includes longpass filters :
(2) filters of each color may be stacked in a single ring.

# 12 yellow	
# 15 deep yellow	recommended to take full advantage
# 21 orange	of the fine tunability of the
# 23A light red	CrimeScope. The FBI recommends
# 25A red	to try a broad selection of camera
# 29 dark red	filters on difficult cases.

The two bandpass filters 530/35 and 570/35 filters allow you to view only the fluorescence from a print without the longer wavelength luminescent background. They act just like the 600/35 nm filter that comes with the CrimeScope, but they should be used with shorter excitation wavelengths (to enhance the prints viewed with orange goggles).
It is always recommended to try to view the prints with the camera filter itself before taking a photograph. (Operate in the dark)
These bandpass filters may be used to separate inks excited with visible light (absorption or fluorescence mode).

The 415/35 nm filter is for blood prints that have to be photographed in daylight conditions (Use 415 nm as the excitation wavelength).
Refer to section 6.1.2 (Table) for the procedure.

The IR longpass filter (#87) allows you to photograph IR fluorescence when using visible excitation or IR absorption when using IR excitation. (Mostly for documents or gun shot residues)
(Remember to use IR film).

WARNING : Wear UV protective goggles !

The UV Output is compatible with the liquid light guide used for the front panel visible Output.

3.4 BIB-150 Hand-Held Black Light

The BIB-150 is a 150 W light source which generates a narrow peak of Black Light (365 nm) in a broad beam ideal for searching.
Refer to the user manual for details. (See Appendix B)

Warning : Wear UV spectacles at all time when using the UV lamp.
The surface of the lamp housing gets very hot.

3.5 Remote flexible arm and and Light Guide

The heavy-duty arm allows you to hold the light guides (IR fiber bundle or UV-VIS liquid light guide collimator or optional remote push-button controller or black light handle). Use the clip clamp.
The arm may attached to the base of a table or its leg or to your camera tripod using the super clamp.
The UV-VIS guide comes with an adjustable collimator : hold the guide and turn the lens holder, the beam size can be increased to twice its original value.

Adjusting the beam size may also be done by changing the distance collimator-surface : remember that the larger the beam the less light per inch square / cm square and the less fluorescence from the latent print.

To photograph a print on a wall at the Crime Scene, you may attach the flexible arm to your camera tripod. For extension rods please contact SPEX.

3.6 Camera filters and goggles

The goggles serve two purposes :
- They protect your eyes against UV and strong visible light
- They eliminate the excitation light when you view fluorescing prints and therefore improve the contrast.

Range of excitation wavelengths compatible with the goggles and filters.

Goggle/Filter	CrimeScope Wavelength Limit	Light leaking through filter above the limit.
UV	Lateral UV or BIB-150	Violet
YELLOW	< 445 nm	Blue
ORANGE	< 515 nm	Green
RED	< 550 nm	Orange

To verify these limits, wear the goggles and scan the wavelength from 415 to 555 nm by looking at any surface illuminated with the light guide. When you reach the limit, you have to switch to the next goggle and filter.

3.8.2 CS-FILT/IR

640-680-720-760-800-840-880-920-960-1000 nm with 35 nm bandwidth

These narrow bandpass filters are for Infrared work and allow you to separete inks (Absorption or fluorescence mode)

This type of work is difficult with a regular camere end IR film because you heve to try every combinetion (IR excitation filter / IR camera filters) until you identify two separate inks.

It is strongly recommended to use a video camere with e CCD sensitive up to 1100 nm.

3.9 Optional Kit of chemicals

- Please refer to Appendix A for Safety preceutions (M.S.D.S.) If the M.S.D.S. for the chemical you want to use is not present in this manual, contect the manufacturer and request the MSDS sheet.

- Please refer to Section 6 and 10 for the preparetion of the shelf solutions and dye processing procedures.

Recommendation :
The inside of the "Fold-A-Lab" enclosure should be waxed before being exposed to superglue fuming. This will meke future cleaning of the chember easier. You mey use cer wax for example.
Operete in a vented room end evacuate fumes outside or use e hood.

The kit contains some common dyes and powders used in the U.S.A.
If you want to limit the number of chemicals you have to use to e strict minimum we recommend :

- Cyanoacrylete for fuming.
- Print-Glo + Red Brilliant magnetic powders.
  (Fresh prints) (Prints on cadavers)
- Basic Yellow-40. (Non porous surfaces)
  (allows you to use longer wevelengths than Ardrox and therefore usually gives less background)
- DFO. (Porous surfeces)

The RAY combination (Rhodamine/Ardrox/Yellow) lets you teke full advantage of the tunability of the Crimescope : you may scan 400-520 nm (end alweys get fluorescence from the prints) until the background is minimized. However the RAY contains Rhodamine which is used by less end less agencies because of the health hazerd. The Rhodamine 6-G should only be handled by fully trained chemists in a laboratory environment (hood, gloves...).

The FBI also recommends MRM and RAM combinations.
RAM usuelly outperforms any singular dye end is itself outperformed by MRM 10.
The edventage of combinetions is thet they allow you to scan a broed excitation range of wavelength until you find one which doesn't excite the background.

4 CRIME SCENE SEARCH

Locating evidence with white light, "CSS" Filter and BIB-150 black light.

The first search at the scene should be conducted with the white light output : no powder / no chemical dye / no goggles.

Set the wheel at the "000" position. (Wheel 2 has to be in "MAX POWER" position).
To photograph a surface illuminated with the white light output, you may decrease the intensity if necessary with wheel 2 : slowly turn it towards the next position.

After the white light search, the following examinations should be performed in a partially (or totally) darkened room.

Before any treatment, a search may be conducted using the "CSS" position and orange goggles as some items may exhibit inherent fluorescence : fibers, greasy prints, body fluids... Aim the CrimeScope directly at the wall if you wish to illuminate a larger area (3 times the spot diameter obtained with the light guide). This may be required when examining a large pattern.
Body fluids may also be located with 445 nm excitation and yellow goggles.

The same items may also be examined with the BIB-150 lamp using the UV spectacles.

Photograph/collect any evidence found with "CSS" or BIB-150.

The same search may be conducted after cyanoacrylate fuming and powdering. Non porous surfaces may be fumed first (refer to 6.1.1) and then processed with magnetic fluorescent powders if the prints are supposed to be fresh. For old prints to be processed with Ardrox / Yellow-40 / Rhodamine-6G, it is safer and more convenient to bring the items to be processed back in the lab.

For fingerprints and other evidence like fibers, the contrast may be improved by scanning the range 400-530 nm using the push-button system and orange goggles.
While holding the brush, you may scan the wavelengths using the optional remote controller.

If evidence was detected with BIB-150, you may photograph it with the lateral UV output and liquid light guide for a more concentrated spot. The deeper UV of the built-in UV may reveal additional evidence. (See Rhodamine-6G samples : they don't fluoresce under 365nm but respond to the deeper UV of the built-in UV). The bulb used in the CS-16 is ozone free ; we just use the best optics to get the strongest and deepest UV we can out the 300 W xenon bulb.

REMEMBER THAT THE LONGER THE WAVELENGTH (THE FURTHER AWAY FROM UV), THE LESS BACKGROUND INTERFERENCE YOU WILL SEE ON 80 % OF YOUR PHOTOGRAPHS.

ALSO REMEMBER THAT THE LARGER THE SPOT THE LESS INTENSITY / cm2 OR /in2. AND THE LESS FLUORESCENCE: Whenever possible try to bring the light guide as close as possible to the surface being processed.

Try not to expose the left side of the CrimeScope (intake fan) to the surface you're powdering.

If ths surfacs you want to photograph using ths CrimsScope can't bs taken back to a dark room (for exampls a vehicle), you may build a spscial tubs which will allow you to photograph a wsak print in day light conditions : start for sxampls from a lsns hood and maks it a longsr tube that will extend all the way from ths lens/filtsrs to ths surface bsing examinsd. Maks a hols on the sids of this tubs with a diamstsr matching ths CS-16 collimator dimsnsions and illuminats ths latsnt print at 45 dsgree or lsss. If your tubs is light tight, you will get an sxcsllsnt ssnsitivity.

5 PHOTOGRAPHING THE EVIDENCE (IN THE LAB OR AT THE SCENE)

5.1 Non luminescent background

Ths camsra should be at 90 dsgrsss from the surfacs. The light source should bs at 45 dsg. (lsss might svsn improvs the contrast).

Use the orange #21 filters if you'vs used the orange goggles to scan ths sxcitation.
Stack 2 or even 3 filtsrs when the surface is strongly reflective and ths excitation is visibls through ths camera filters.

If you havs the optional kit of long pass filters, sxamine the print with ths filtsrs thsmsslves (not the goggles) and adjust the wavelength with ths push-button and the fine tune knob. Ths optional kit of filtsrs allows you to get the optimum contrast on a difficult case, but may not bs ussd systsmtically bscause of the tims rsquirsd to try all the filters.

5.2 Luminescent background

Improving the contrast in presence of a luminescent background may be dons in two steps :

1/ Scan ths excitation wavslength. Try the orangs goggles/filters first and then the red onss (whsn using excitation wavslengths abovs 515 nm).
You're trying to find a wavelength sxciting ths latent print but not ths surfacs. This dossn't mean you look for the brightsst print but just a wavelsngth that minimizes the background whils still sxciting the print.
Use long pass filters on your camera : # 21 -23A ...
If the sxcitation wavelength only gives optimum results in a very narrow rangs try the optional longpass filters (CS-FILT kit) that allow you to just block the excitation light but transmit maximum fluorsscsncs.
If ths contrast is not accsptable, go to step 2.
For most surfacss scanning towards the long wavelengths will rsducs background luminescencs. Ths UV outputs (lateral and BIB-150) ars rsquirsd for UV dyss, tracs wound patterns, prints on skin and all body fluids and fibsrs : ths UV is vsry ussful to locats the svidencs. Howsver ths photographs taken undsr UV excitation are usually more blurry than ths onss taksn with blue or green...
(Rsmembsr to uss one or two UV blocking filtsrs in front of your camsra for both the lateral UV and BIB-150 : they will sliminats UV reflscted light but no background fluorescsncs.)

2/ If both the latent print and surface are excited by the same wavelengths, you may then use bandpass filters in front of your camera so that you can separate the two emissions (if they are different).
The 600 nm 35nm bandpass filter which comes with every CrimeScope allows you with a DFO treated print to separate the orange/light red fingerprint fluorescence from the red paper/cardboard fluorescence. (Do not over expose)

The long pass # 23A filter may be used too.
If you experience too much background with the chemicals you're using, you may need the two bandpass filters part of CS-FILT (530 nm and 570 nm with 35 nm bandwidth). The light red or orange fluorescence from the surface is transmitted through the orange longpass filters and might be stronger than the green fluorescence from the latent print : the 530 nm filter will eliminate the orange/light red fluorescence and only transmit the green light.

It is particularly recommended to try different exposure times when using bandpass camera filters.
When using DFO you see only a red background on your photographs, try to underexpose and also try to shift your excitation towards the blue (coming from the green).

5.3 Infrared work

When the fiber bundle is not connected to the IR output, you will see some visible light coming out : 95 % Infrared and 5% visible/red. There's about 1200-1500 mW of IR radiation output : it feels like heat on your skin.

4 filters come with the fiber optic :

The 630 nm long pass filter is permanently mounted in the holder. The 3 other filters (715/780/830) may be installed on top of the the 630 nm one. One or two may be stacked on top of it.

To identify the filters, look at daylight or at an incandescent bulb (not fluorescent light), the filter that transmits more red light is 630 nm. The less red light you see the higher the wavelength : 830 nm doesn't transmit any red light (looks black). Filter may be marked with a different number of cuts on the side 1 cut for 630nm, 2 for 715, 3 for 780 and 4 for 830. (A cutter may used).
It is preferable to install the 715 nm filter between the permanent one (630) and either the 780 or 830nm to avoid overheating of these filters.

By eliminating the visible light and dark red, these 4 filters improve the signal to noise (contrast). For example if the paper of the document you're examining or the inks themselves fluoresce under red excitation use at least the 715 or even a longer wavelength for the excitation.

For document examination a VIS/IR video camera is much more convenient and faster than a regular camera with IR film.
Use the optional kit of IR bandpass filters to identify different inks.

Each ink is characterized by absorption and emission bands and switching the various filters part of the CS-FILT/IR allows you most of the time to separate different inks.

Example where an IR detector is not required :

On a check , if you overwrite with a marker information originally typed on it to hide it, you can make it visible by exciting with the 630 nm filter (red-IR) at a very oblique angle. Observe with naked eye (no filter).

6 APPLICATIONS

6.1 Latent Fingerprints

Enhancement of latent fingerprints and other evidence with a tunable forensic light source and a range of standard and custom camera filters.

Some substances fluoresce when excited by a particular range of light (particular color) : the material absorbs the exciting light and re-emits light at a longer wavelength. The shift between the absorption band and the emission band is called "Stokes Shift". Following is a list of chemical dyes used for latent fingerprint enhancement with the corresponding excitation wavelengths and recommended camera filters. (See tables)

The key parameters for excellent fingerprint photographs are :

* The selection of the excitation wavelength that will induce maximum fluorescence from the print and minimum background interference (luminescence or reflection).
  --> a continuously tunable and powerful source is required.

* The blocking of both the excitation light and of the background luminescence before they reach your photographic film.
  --> a wide range of edge and bandpass filters with high light purity should be used for both the excitation and camera.

You can't systematically trust your eyes : they have a much lower sensitivity than photographic film in the UV-Violet region and the red-NIR region.
A visual examination with long pass goggles may show good prints while the camera with a similar long pass camera filter won't provide an acceptable contrast and vice-versa.
(See example of DFO on luminescent paper : a bandpass filter has to be used to block the paper fluorescence (above 620 nm) which is detected by the photographic film).

Each chemical dye is characterized by an absorption peak and an emission peak. SO IS THE BACKGROUND !
By tuning the excitation and trying different longpass and bandpass camera filters you can find most of the time a combination that minimizes the background and still provides enough intensity from the latent print. The recommended procedure is to try :

- First a long pass filter which transmits in the region of the emission peak for the dye you're using. (the long pass filter allows short exposure times).

- If the contrast is not acceptable, then try the two closest bandpass filters (one centered below or at the peak and one centered above the peak). The SPEX table provides the emission range for each dye.
  The emission peak for DFO is around 580 nm : both the BP570-35 and BP600-35 filters should be used because you don't know the background characteristics.
  If the background emission peak is below 580 nm, the BP600-35 camera filter will give good results. If the background emission is above 580 nm use the BP570-45 and tune the excitation towards the shorter wavelength.

6.1.1 Superglue Fuming (Cyanoacrylate)

To use any of the cyanoacrylate dyes (Basic Yellow-40, Rhodamine-6G, Ardrox, RAM, MRM 10, MBD...), non porous items have to be fumed first with a cyanoacrylate ester which will bound (secure) the residue to the surface.

"It has been found that the minimum amount of fingerprint residue needed for the adherence of a fingerprint powder is 500 to 1000 ng (1ng=0.000000001g) When the quantity of the fingerprint residue is less, the print will appear faint or insufficient for identification purposes.
It also has been measured that the development of fingerprints by chemical methods (colored dyes...) requires 100 to 200 ng of residue.

This is 5 times as sensitive as conventional powders. Within the past 15 years, newer techniques were developed utilizing photoluminescence, that is the ability of certain chemicals under exposure to specific wavelengths to absorb and re-emit light at longer wavelengths (different color). These techniques could be 10 to 100 times more sensitive than conventional powdering techniques.
The CA (cyanoacrylate) technique prevents the residue from being washed away by the solvents used to dissolve the dyes.

Latent fingerprint polymerization should be visually monitored to avoid over-development of background surfaces. A known fingerprint deposited on aluminum foil may be used as a reference.

Excellent results have been obtained from plastic bags, guns, metal coin boxes, cash register drawers, etc..." John Olenik (Ohio BCI).

The fuming may be done with or without heating or may be performed under vacuum (best but inconvenient).

In the laboratory fuming chambers, 5 ml of liquid ethyl cyanoacrylate per cubic feet of tank volume is recommended.
For large areas, good results have been obtained using 100 ml of adhesive (CA) for an 8000 cubic feet scene.

Other examples :	Compact cars	4 pouches	3 cups of water	2.5-4 hours
	Medium/large cars	6 pouches	3 cups	2.5-4 hours
	Vans	8 pouches	3 cups	2.5-4 hours

When using the Lynn-Peavey chamber (part of our CS-CHEM kit), a 15-20 min fuming is usually enough. If you overfume, the entire background will fluoresce.
"Always use aluminum foil to spread the superglue : prepare a "CA" sandwich with a 6x8 in (15 x 20 cm) piece of aluminum foil by making a widthwise crease down the middle. A thin bead of CA is placed on the aluminum foil, midway between the crease and the edge of the foil, and 12 mm (1/2 in) in from the edge. The foil is folded over onto the cyanoacrylate bead and a fingerprint ink roller or similar cylindrical object is rolled on the foil to evenly distribute the CA. The fuming process will start as soon as the foil is pulled apart." John Olenik Ohio BCI
Just before you start the process place a glass of warm (not hot) water so that the humidity rises to around 80 % which is the ideal value.
For more about this technique or to learn about the heat/vacuum techniques, we recommend the workshop from Detecto-Print.

SUPERGLUE FUMING SHOULD BE PERFORMED IN A WELL-VENTILATED AREA.
There are several hazards associated with Superglue (Skin adhesion, irritating vapors...)

ISA JY/SPEX ASSUMES NO RESPONSIBILITY FOR THE USE OF CYANOACRYLATE AND OTHER CHEMICAL DYES MENTIONED IN THIS MANUAL.
TAKE PROPER PRECAUTIONS WHEN HANDLING CHEMICALS AND POWDERS.
DYE STAINING SHOULD ONLY BE CONDUCTED IN A LABORATORY BY FULLY TRAINED PEOPLE. (Use a hood, gloves, masks...)

6.1.2 Luminescent Dye Staining Techniques

DYES AND RECOMMENDED WAVELENGTHS FOR LATENT PRINTS

DYES	TYPE OF SURFACE	SURFACES	BEST EXCITATION	CAMERA FILTER Longpass	Bandpass
SUPERGLUE / FLUORESCENT POWDER	Non Porous (on glossy paper : fresh prints only)	Plastic, Glass, Paint, Metal	UV(280-380) 380-510 nm 510-560 nm	YELLOW or UV Blocking ORANGE	or BP530-35 or BP 570-35 RED or BP 600-35
SUPERGLUE / RHODAMINE	Non Porous	Plastic, metal	480-500 nm 500-540 nm also short UV	ORANGE	or BP 570-35 RED or BP 600-35
SUPERGLUE / BASIC YELLOW-40	Non Porous	Plastic, metal, treated wood	420-500 nm	ORANGE	or BP 570-35
SUPERGLUE / ARDROX	Non Porous	Plastic, metal, cellophane, treated wood	UV(280-380) 380-450 nm	YELLOW	or UV blocking YELLOW or BP 530-35
NINHYDRIN + Zinc + Cadmium	Porous	Paper Cardboard	400-480 nm 480-500 nm 500-520 nm	YELLOW	or BP 530-35 ORANGE or BP 570-35 RED or BP 600-35
DFO (+ Zinc : may reveal more prints)	Porous	Paper (brown,Kraft) Cardboard	450-510 nm CSS or SP580 510-560 nm	ORANGE	or BP 570-35 RED or BP 600-35
PHYSICAL DEVELOPER or LSR Solution	Porous reacts with Lipids/oils	Paper/ Wood Concrete Latex / Tape	White 450-510 nm 510-560 nm	No filter-reflection mode ORANGE	or BP 570-35 RED or BP 600-35

6.2.2 Detection of body fluids, blood stains and prints, and other evidence

DETECTION OF BODY FLUIDS, DRUGS, FIBERS, GREASE, BITE MARKS, PAINT,	FOR SEARCHING : UV(280-380) / 365 nm (+ UV Goggles) also420-445nm (yellow filter) CSS Broad excitation filter (350-520 nm) (+ Orange Goggles)	FOR PHOTOGRAPHY : Use UV / yellow filters Tune Excitation between UV and 540 nm. Use orange camera filter or BP530-35 or BP 570-35 to enhance contrast.
BLOOD STAINS BLOOD PRINTS (Blood absorbs around 415 nm) (Data from M.Stoilovic F.S.D. A.F.P)	Dark/Shiny background: White/Colored surface : White/Colored surface faint print / porous surface :	480-540 nm + no camera filter 415 nm excitation _ dark conditions : no camera filter _ daylight conditions : use BP 415-35 camera filter. Treat with DFO (see above recommended wavelengths and camera filters).
QUESTIONED DOCUMENTS GUN SHOT RESIDUES	USE broad Excitation wavelengths from 400 to 1100 nm : CSS filter, bandpass and edge filters (longpass/shortpass)	Use narrow bandpass camera filters (530 to 1000 nm) to separate inks and enhance contrast. (There are 14 camera filters offered for the CrimeScope).

7. MAINTENANCE

7.1 Xenon bulb replacement (CS-16)

It is recommended that the xenon bulb be replaced every 800/1200 hours. Once every 3-4 years or when the power output is clearly reduced.

Usually the bulbs don't fail but their power keeps decreasing: Between the time it is delivered to you and 1000 hours of operation the output power goes down by 10 to 30%. Before replacing the bulb check the fluorescence of a stable latent print (you may record the exposure time). Once the new bulb is installed you may check that the fluorescence is brighter.

The replacement of the bulb can only be performed when it is cold. Leave the fans on for 10 min. to cool all the optics down to the ambient temperature.

The output intensity of new bulbs may vary a lot from one bulb to another during the first 15-20 hours of use.

PROCEDURE:

Caution:

!!Make sure the power is off and power cord is disconnected!!

!!Do not touch optics with bare hands (mirrors/lenses/filters....). If accidentally touched, wipe it gently with a tissue moistened with alcohol (or lens paper) and blow dry air to eliminate dust!!

!!DO NOT CLEAN THE LATERAL UV FILTER!! It has a special fragile coating.

!!Do not touch face of bulb with bare hands!!

a/ Remove the cover of the instrument.

b/ Remove the lateral door in front of the black lamp housing.

c/ Remove the four thumb screws, accessible from the lateral door, from the black lamp housing by hand or with a slotted screwdriver.

d/ Pull the blue plastic heatsink shield out of the lamp housing.

Caution:
The xenon bulb is under high pressure. Wear safety glasses and/or face shield to protect your face in case bulb is dropped or broken.

e/ Unscrew the two brass high voltage banana plug sockets from the blue heatsink shield. Note which position each screw came out from since they are different thread sizes.

f/ Remove the two heatsinks with the bulb in the center from the heatsink shield.

g/ Pry off the copper clips from the heatsinks and remove the old bulb. Again note which heatsink is in the front and rear.

Caution:
The old xenon bulb is still under pressure. Wrap the bulb complete and/or place in a closed container before disposing.

h/ Put a thin film of thermal paste on silver metal rings around the new bulb using a cotton tip.

Caution:
!!DO NOT TOUCH WINDOW OF LAMP WITH BARE HANDS!! If you do, use a tissue moistened with alcohol to clean it. If the marks do not disappear, contact the factory.

i/ Insert the front of the new bulb into the front heatsink (the one with a single screw tape). Make sure the bulb is seated all the way forward before replacing the copper clip.

j/ Line up one of the holes in alignment jig (part no. 350373) with the front heatsink. Screw in the brass high voltage banana plug socket with the smaller threads.

k/ Slide the rear heatsink over the bulb until the first screw hole lines up with the hole in the alignment jig. Then screw in the second brass high voltage banana plug socket.

l/ Attach the copper clip to the rear heatsink and remove the alignment jig. Make sure the bulb is securely held by the two heatsinks.

m/ Insert the heatsink and bulb into the blue plastic heatsink shield. The front of the heatsink shield has a large notch on the underside. This notch is flanked by two small set screws.

n/ Replace the two brass high voltage banana plug sockets. The smaller size threads go in the front.

o/ Reinsert the blue plastic heatsink shield into the lamp housing. The front of the bulb should face the lens. Check to make sure that the banana plugs are properly seated.

p/ Replace the lamp housing cover and tighten the four thumbscrews. Use a screwdriver or pliers to tighten (Hand tightening is not enough).

q/ Replace the lateral door and instrument cover.

r/ Plug the unit in and turn it on. Immediately go to the white light setting and check that UV is off.
The bulb should be burned for 1 hour before use in the UV setting. Ensure that the fans are working. Contact the ISA service department if there are any problems.

MATERIAL SAFETY DATA SHEET

(EFFECTIVE DATE: 9/1/93)

Detecto Print
P.O. BOX 224, 1531 E. State St.
Fremont, Ohio 43420
Phone 419-334-8777; FAX 419-334-7775

SECTION 1 - MATERIAL IDENTIFICATION AND USE

TRADE NAME: PRINT GLO

FORMULA: A FLUORESCENT MAGNETIC FINGERPRINT POWDER

SECTION 11 - PRODUCT INGREDIENTS

* No ingredient, present at 1% or more, is contained in the SARA Title III, 313 list.

MAJOR INGREDIENTS

MATERIAL	C.A.S. #	TLV 3
Iron Powder	7439-89-6	10 mg/m 3
Iron Oxide	1317-61-9	10 mg/m

HMIS Rating: Health I; Flammability O; Reactivity O

SECTION III - PHYSICAL DATA FOR MATERIAL

BOILING POINT: n.a. SPECIFIC GRAVITY: 2.8

VAPOR PRESSURE (mm Hg): n.a. EVAPORATION RATE: n.d.

SOLUBILITY IN WATER: Negligible PHYSICAL FORM: Powder

ODOR: Odorless COLOR: Dark Grey

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: n.a. FLAMMABLE LIMITS: n.a.

EXTINGUISHING MEDIA: Graphite; Sodium Chloride

SPECIAL FIRE FIGHTING PROCEDURES: Fog nozzle and fine spray to prevent dusting.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Fine dry dust exceeding minimum explosive concentration can explode in presence of ignition

SECTION V - HEALTH HAZARDS

THRESHOLD LIMIT VALUE: n.a.

EFFECTS OF OVEREXPOSURE: Slightly dusty material may cause eye, skin and mucus membrane irritation

EMERGENCY AND FIRST AID PROCEDURES:

EYE: Flush with copious amounts of water

SKIN: Flush with water

INHALATION: Remove subject to fresh air

SEEK MEDICAL ATTENTION

SUPER GLUE SAFETY AND HANDLING

Cyanoacrylate adhesives are all clear liquids at room temperature, and are considered lachrymators; that is, they can cause extreme eye and nose irritation. This is why super glue fuming should be performed in a well-ventilated area. Either a fume hood (laboratory type) or exhaust fan should be used close to the fuming area.

If a large quantity is spilled, it should be treated with water, in order to rapidly cure-out the glue, and render it safe.

Another hazzard is that it is a skin bonder; and if this happens. you should have super glue solvent available; there are several sold commercially. If you have a chemical source, there are several solvents that can be used; some being nitromethane, MEK (Methylethylketone) and Acetone. (See attached First Aid Sheet).

The liquid super glue in large quantities (one-ounce bottles to one-pound bottles) should be refrigerated. This prevents the glue from prematurely curing out, due to age or moisture contamination, and thus extends the shelf life; however, after being removed from the refrigerator, it should be allowed to sit and adjust to room temperature before opening the container. If not refrigerated, a bottle of super glue will slowly thicken and lose it's effectiveness, approximately 6 months to one year after time of manufacture, depending upon room temperature.

Information for First Aid and Casualty on Treatment for Adhesion of Human Skin to Itself if caused by Cyanoacrylate Adhesives

Cyanoacrylate adhesive is a very fast setting and strong adhesive. It bonds human tissue including skin in seconds. Experience has shown that accidents due to cyanoacrylates are handled best by passive, non-surgical first aid. Treatment of specific types of accidents are given below.

Skin Adhesion
First immerse the bonded surfaces in warm soapy water.
Peel or roll the surfaces apart with the aid of a blunt edge, e.g. a spatula or a teaspoon handle; then remove adhesive from the skin with soap and water.
Do *not* try and pull surfaces apart with a direct opposing action.

Eyelid to Eyelid or Eyeball Adhesion
In the event that eyelids are stuck together or bonded to the eyeball, wash thoroughly with warm water and apply a gauze patch. The eye will open without further action, typically in 1—4 days. There will be no residual damage. Do *not* try to open the eyes by manipulation.

Adhesive on the Eyeball
Cyanoacrylate introduced into the eyes will attach itself to the eye protein and will disassociate from it over intermittent periods, generally covering several hours. This will cause periods of weeping until clearance is achieved. During the period of contamination double vision may be experienced together with a lachrymatory effect, and it is important to understand the cause and realise that disassociation will normally occur within a matter of hours, even with gross contamination.

Mouth
If lips are accidentally stuck together apply lots of warm water to the lips and encourage maximum wetting and pressure from saliva inside the mouth. Peel or roll lips apart.
Do *not* try and pull the lips with direct opposing action.
It is almost impossible to swallow cyanoacrylate. The adhesive solidifies and adheres in the mouth. Saliva will lift the adhesive in ½ to 2 days. In case a lump forms in the mouth, position the patient to prevent ingestion of the lump when it detaches.

Burns
Cyanoacrylates give off heat on solidification. In rare cases a large drop will increase in temperature enough to cause a burn.
Burns should be treated normally after the lump of cyanoacrylate is released from the tissue as described above.

Surgery
It should never be necessary to use such a drastic method to separate accidentally bonded skin.

Published by:
Loctite Corporation, 705 North Mountain Road, Newington, Connecitcut 06111

Loctite Corporation

705 North Mountain Road
Newington, Connecticut 06111
Telephone: (203) 278-1280
Telex: 99348

STATEMENT ON THE TOXICITY OF CYANOACRYLATE VAPOR

Based on the following analysis, it is our firm belief that exposure to the amount of cyanoacrylate vapor generated by use of the Hard Evidence Fingerprint Developer does not constitute a threat to health.

Toxicological testing has shown that the LC_{50} of cyanoacrylate vapor is approximately 600 mg. per cubic foot of air. The term LC_{50} refers to that concentration of a chemical vapor which is lethal to half of a group of test animals. By way of comparison, the LC_{50} of methyl alcohol is about 30 mg. per cubic foot; of trichloroethylene 380 mg. per cubic foot.

Under normal conditions of use, the concentration of cyanoacrylate vapor will never approach the LC_{50}. For example, three grams of liquid cyanoacrylate, if totally vaporized in an area of 125 cubic feet (an enclosure 5 feet X 5 feet X 5 feet), will produce a maximum vapor concentration of 24 mg. per cubic foot assuming uniform distribution. This concentration is less than 5% of the LC_{50}.

It should be noted, however, that exposure to cyanoacrylate vapor at concentrations below the LC_{50} may produce irritation to the eyes, nose, and throat. The odor of cyanoacrylate is generally perceptible at a concentration of about 1 ppm. Throat and nose irritation begin at about 2-3 ppm; eye irritation at 4-5 ppm. Concentrations above 20 ppm may cause tearing and the discharge of mucous.

It is recommended that when using cyanoacrylate vapor as a fuming agent for latent print development, all areas be thoroughly ventilated after fuming and before reentry. This will minimize the discomfort and short-term effects.

For more information concerning toxicity of cyanoacrylate vapors, please call your local distributor or John Hammond at Loctite Corporation (203) 278-1280.

M. Hauser, Ph.D.
Vice President
Environmental Health
and Safety
Loctite Corporation

AGE OF FINGERPRINT (HOLYST 1987)

	OUTDOORS (Days)			INDOORS (Weeks)		
	glass	metal	plastic	glass	metal	plastic
Sweaty prints	5.8	4.2	3.3	12.2	10.1	7.5
Greasy prints	25.8	20.5	19.5	73.2	47.6	28.2

SWEATY PRINTS : HIGH ECCRINE CONTENT

GREASY PRINTS : HIGH SEBACEOUS CONTENT

CONSTITUENTS OF FINGERPRINTS :

- 98 % WATER
- SECRETIONS FROM SUDORIFEROUS ECCRINE (HANDS) & APOCRINE GLANDS. (Amino-acids, urea, uric acid, ammonia, chlorides...)
- SECRETIONS FROM SEBACEOUS GLANDS (fatty acids, hydrocarbons...)

USE OF CRIMESCOPE FORENSIC LIGHT SOURCE ON :

POROUS SURFACES (DRY)	NON POROUS SURFACES (DRY)
DFO	CYANOACRYLATE FUMING
NINHYDRIN	PHOTOGRAPHY (IF VISIBLE PRINT)
ZINC OR CADMIUM NITRATE	STAIN (DYE OR POWDER)

FLUORESCENCE PHOTOGRAPHY
TUNE EXCITATION TRY DIFFERENT EMISSION FILTERS

a/ WARNING

Non porous gloves, laboratory coats and safety goggles should always be worn when working with chemical dyes. Application should always be conducted in a fume hood.
Refer to the MSDS for safety precautions.

b/ BASIC RULES

_ Underfume rather than overfume. (Otherwise the entire background will fluoresce).

_ " Fluorescent dyes may be applied before or after fingerprint powders, although generally better results will be obtained by the use of dyes prior to the use of fingerprint powders"
" Dipping generally gives the best results, while spraying has the greatest health and safety risk"
" The items should be allowed to dry until all the carriers have evaporated"
" In some instances, elimination of fluorescent spotting and contrast improvement may be achieved by rinsing the item with petroleum ether."
" Some of the latent prints that fade may be restored with reapplication of the dyes"
H.Cummings, M.Hollars, T.Trozzi (FBI - Journal of forensic Identification 93)

_ If you see background interference with a particular dye (for example a surface treated with Ardrox fluoresces under UV and violet (415-430nm) excitation), try another dye (like Yellow-40) which requires a different/longer wavelength (450-470 nm).

_ When using a forensic light source, DFO must be applied before ninhydrin.
Physical Developer or LSR aqueous solutions must be used after DFO and ninhydrin.
If you don't use ninhydrin but just DFO, you may want to experiment Zinc secondary treatment : it may reveal more prints (Always photograph the print before a secondary print).
The experiments conducted on a SPEX spectrofluorometer confirm one should expect more fluorescence from a DFO treated surface after secondary Zinc treatment.

_ Use the camera bandpass filters when the background exhibits a strong broad luminescence. For example when photographing a DFO print, the visual examination with red goggles may show a good contrast. However a photograph with long pass red filter may show a strong red fluorescence from the paper which hides the latent print. This happens because the film is more sensitive than the eye to red/dark red. Using the BP 600-35 filter will prevent the red fluorescence (above 630 nm) from reaching the film.

6.2 Other Applications

6.2.1 Trace wound patterns and prints on human skin

The detection of prints on human skin is very difficult and not reproducible from one subject to another one.
The methods mentioned below are some of the best ones but do not guarantee results.

SPECIAL TECHNIQUES

WOUND PATTERNS (BITE MARKS, BRUISES, CUTS)	NO TREATMENT Try different wavelengths :	UV(280-380nm) UV Black Light 445 nm CSS	_ use UV blocking filter _ Yellow filter _ Orange filter
LATENT PRINTS ON HUMAN SKIN (CADAVERS)	3-4 min Fuming + Brilliant Red Powder 1 hour Fuming + TEC (Thenoyl Europium Chelate)	UV(280-380nm) 365 nm Black Light (+ UV filter) UV 365 nm (+ BP 640-35 or BP 620-10 camera filter)	1 Hour to 12 hours after fuming. conducted within 24 hours of death.

Data from M. West, R.Barsley, S.Hayne (Journal of Forensic Identification)
Photography of Trace Wound Patterns

Data from FBI (Ivan R. Futrell (Brilliant Red Powder))
from Royal Canadian Mounted Police (A.H. Misner (TEC)).
(Journal of Forensic Identification)

"There is little hope of ever detecting latent prints on alive victims. Details are lost within 30 min after contact by diffusion of the latent print residue which remains essentially liquid at 32 deg. C, the approximate temperature of living skin. The change of the latent from a liquid to a viscous condition and thus the rate of diffusion will depend on the rate of cooling of the body after contact."

Examples of trace wound pattern discovery in criminal investigation
(Journal of Forensic Identification dec92 - M.West).

" Bite marks, bruises, cuts, etc. are enhanced and made visible to the eye by illuminating the area with a narrow band of UV light or centered at 450 nm and viewed through yellow goggles.
... Patterns can persist over 10 days or more ...
Three people were murdered with a large butcher knife. The knife was identified as the murder weapon by wear patterns and notches on the blade. The handle was wood, riveted to the shank. The wood on the right side of the handle was missing, exposing two intact rivets and one broken rivet. A suspect was examined ten days after the assault, and the pattern of the rivets was found on his hand. The pattern was not visible under normal light or UV.

Three juveniles were charged with the murder of an elderly woman. She had been bludgeoned with a galvanized water pipe. Four days after the assault the suspects' hands were examined, and one of the boys had a pattern in the palm of his hand consistent with the leading edge of the pipe.

A three and a half month old infant was brought to the morgue. Shaken Infant Syndrome was suspected as cause of death. The body was examined under forensic light and a pattern consistent with hands seizing the child by the chest were found. (Note : after the body had been embalmed, the pattern could no longer be seen).

A 28 year old white female was kidnapped, raped and murdered. A ligature made from her purse strap was found around her neck.
At the end of the strap was hanging a broken buckle. Four days after the assault, a suspect was examined. A pattern was found in his right hand that matched the broken buckle. Using the buckle, one of the authors was able to reproduce the pattern in his own hand.

A 20 year old black male was a suspect in a shooting death. The weapon was a single shot shotgun with a broken stock with only the stock bolt extended and used as a pistol grip. Twenty-four hours after the incident, the pattern was found in the hand of the suspect.

APPENDIX C : Examples of applications with wheel 2 (Contrast wheel)

The 4 edge filters (Short pass and long pass) transmit much more power than bandpass filters.

(See example under section 3.2 wheel "CSS + LP480" can totally eliminate background interference due to low wavelengths in several cases).

1/ Looking at a DFO print on paper/cardboard, first look at the print with wavelengths from 575 down to 555 nm (on wheel 1) and with red goggles (or red bandpass/longpass camera filter).

Change the position on wheel 2 from "MAX POWER" to SP580.

This will allow you to excite with a very narrow band as close as it can be to the red goggles. (No background due to low wavelength exciting the paper or other surface.)
Also the light purity is increased above 580 nm from the regular 10-6 to 10-12 which is useful when the surface is strongly reflective.
Also try to use just SP580 (set wheel 1 to "000" -> white) when you need maximum power for a weak print.

2/ When performing a search with the CSS filter (wheel 1) and "MAX POWER" position on wheel 2, you may want to take some photograph of evidence of evidence on strongly reflective surfaces. Just set wheel 2 to SP520.

3/ SP520 may be used in a stand-alone mode (wheel 1 on "000" position) for searching on a surface with dyes that don't respond under green excitation (Yellow-40 / Ardrox).
or use SP520 and SP580 for fluorescent inks with IR examination.

4/ For document examination use LP 480 or LP 530 in combination with an IR camera. (You may see both fluorescing inks as well as absorbing inks as opposed to the inks you see with the IR filters like 780 and 830 nm in the absorption mode).

5/ When using crystal violet (on tape) or physical developer which are substances that don't fluoresce, you may still improve the contrast a lot by trying to work in the reflection mode :

Use one of these filters :

LP530 (+"000")
575-600-640

Usually no filters is required in front of the camera, but users have reported improvement with orange and red filters.

6/ Those same above filters can may also be used in the absorption/ reflection modes with amido-black / protein stains (also : shoe prints...).

ADDENDUM (FOR CS-16 DELIVERED AFTER 1995)

1/ The CS-16 now comes with both a carrying bag and a rugged carrying/shipping case with wheels.

2/ The UV black light (365nm) is now an option.

3/ On wheel 1 (automatic), the 575 position now features a shortpass filter transmitting from 380nm to 575nm. This powerful filter may be used for weak DFO prints. Observe with red goggles. The color for this broadband filter contains violet-blue-green. If the paper fluoresces below the print, use the 535 filter or the 555 (fine tuned by about 10-15) with red goggles.

On wheel 2, SP580 now features a bandpass filter centered at 575nm (used for document examination).
LP530 is an open position and LP480 is a yellow filter which may be combined with wheel-1 filters such as CSS or 575 to reduce strong background fluorescence.
SP540 is a shortpass filter which may be combined with CSS and orange goggles when the background is strongly reflecting.

4/ The CS-16 liquid light guide now comes with a rugged dual shield: The internal jacket is made of aluminum and plastic. The outside is stainless steel.
The less bend on the liquid light guide, the more light intensity. When packing your light guide, try not to bend it excessively.

ANNEX B:

LUMINESCENT DYE STAINING TECHNIQUE

By John Fisher

One of the most valuable techniques for obtaining latent prints on a variety of non-porous surfaces is that of staining with luminescent dyes. This technique has proven quite successful on such items as glass, firearms and plastic.

The item to be processed is first fumed with Superglue (cyanoacrylate ester) in an effort to detect and stabilize the latent prints. A luminescent dye solution is then applied by using a wash bottle or dipping the item into the dye solution. The item may then be washed with a rinse solution that corresponds to the particular dye solution, in an effort to remove excess dye from the item being processed. Information concerning the dye formulas and their preparation will follow in section B. Section B lists many of the dyes frequently used, but is not all-inclusive.

Much of the success of the dye staining technique is due to the fact that the Superglue reacts with minute traces of fingerprint residue. These prints may not be visible in ambient light or easily detected by other mechanical means such as processing with latent powders. The luminescent dyes react with the Superglue Fumed print, staining the visible prints as well as the faint to imperceptible prints. Once the excess dye has been washed away, the latent prints are generally detected by illuminating the item with blue-green wavelengths of light. The blue-green wavelengths of light excite the dye which has selectively bound to the Superglued latent, allowing for the luminescent detection of weakly Superglue developed latents.

Section C is provided as a reference for the dye solutions in their corresponding excitation wavelengths as well as the color or wavelength of the filters used for visual observation of photography.

SECTION A: SAFETY CONSIDERATIONS

In the preparation and use of the luminescent dye solutions, it is important to institute safety measures to prevent injuries to the eyes, skin and respiratory tract. Basic laboratory equipment should be provided for personal protection. This equipment should include, but not be limited to, the following items:

Face shield or goggles – to protect eyes and face from accidental splashing of chemical solutions.
Lab coats – to protect clothing and to provide an extra barrier in the case of a spill or splash.
Chemical resistant gloves – to protect hands, providing a physical barrier against solid and liquid chemicals. The hands should always be washed after using the glove to minimize contamination.
Respirators – to protect the respiratory tract from solvents and other chemicals that may exist in an atomized or gaseous state. Note that the appropriate respirator cartridge must be used when dealing with hydrocarbon and acid fumes. Whenever possible, prepare and apply chemicals in an exhaust fume hood. Do not expose flammable chemical to flames or electrical sparks. Never smoke, eat or drink within the proximity of the processing areas.

SECTION B: LUMINESCENT DYE FORMULAS AND THEIR PREPARATION

ARDROX

Ardrox is frequently used in a variety of formulations. Articles stained with Ardrox may be examined with a longwave ultra-violet light, or excited in the visible range with blue to green light (400nm – 525nm). Ardrox is an industrial penetrant and is commercially available. It is normally used in a 1 or 2 percent solution.

The Ardrox dye solution should be prepared in a fume hood or an area with adequate ventilation. Note that the solvent used in the dye preparation is extremely flammable.
The article to be examined should be fumed with Superglue. Examine the article in good lighting and photograph any visible prints. Wash or dip the article into the Ardrox solution. Allow the stain to penetrate for 30 seconds to 2 minutes. Rinse thoroughly with slow running tap water to remove excess dye. Do not use other solvents to rinse. Allow the article to dry and examine with the CrimeScope.

Ardrox in Methanol
(Vachon-Sorel solution)
2ml Ardrox P-133D
100ml Methanol

Ardrox in 2-Propanol
(Olenik solution)
100ml Ardrox P-133D
100ml 2-Propanol
5ml Acetonitrile

Basic Yellow 40 (Panacryl Brilliant Flavine 10GFF)

Basic Yellow 40 has been shown to be most effective of those dyes shown in the Manual of Fingerprint Development Techniques. It is believed to be safer than

Rhodamine 6G. It may be examined using an ultra-violet light or excited with blue green light.

Note: Basic Yellow 40 is prepared in Methanol which is extremely flammable.

Fume articles with Superglue, examine and photograph any visible prints. Apply Basic Yellow 40 with a wash bottle or dip the item. Allow dye to penetrate for approximately 30 seconds to one minute. Rinse thoroughly in slow running tap water to remove excess dye. Dry and examine the article with the CrimeScope.

Basic Yellow 40
2g Basic Yellow 40
1000ml Methanol

MBD [7-(p-METHOXYBENZYLAMINE)-4-NITROBENZ-2-OXA-1,3-DIAZOLE]

This technique was developed for the latent print detection by the FBI's Latent Fingerprint Section Research Team. It has the abilities to cause latent fingerprints fumed with Superglue to fluoresce strongly and to make blood prints highly visible on most latex and some oil painted surfaces. The developed Superglue latent prints can be excited to luminesce between the wavelength of 250-500nm. However, the general working region is 450nm-500nm. After application, items must be allowed to dry in such a way that the excess chemicals can readily drain off. If the excess is not allowed to drain, fluorescent spotting will occur. Rhodamine 6G and other fluorescent dyes may be used after the use of MBD. The Methanol formula usually produces a more highly luminescent print than other formulations.

Note: The preparation of the MBD reagents require the use of highly flammable solvents, therefore, adequate ventilation is necessary.

In the preparation of the Methanol in MBD formula, simply dissolve the MBD into the Methanol and the working solution is ready for use.

With regard to the Quick Dry formula, dissolve the MBD in Acetone. After the MBD is fully dissolved, add the reagents in order of occurrence in the formula.

Fume the article being processed with Superglue, examine for any visible prints and photograph if prints are present. The MBD may be applied by dipping or by rinsing or using a wash bottle. After the MBD is applied, the item must be allowed to dry until all of the solvent has evaporated. The item should be hung to dry in order to avoid fluorescent spotting. (It should be noted that it is not necessary to rinse the item being processed with the MBD.)

Note: The Methanol MBD formula may be destructive to some painted surfaces. Should this be the case, the Quick Dry formula can be used for the enhancement process.

Examine the article using the CrimeScope. Avoid exposing the article to prolonged periods of heat and light, since MBD luminescence will tend to diminish. Latent should be photographed expeditiously.

MBD in Methanol
0.03g MBD
1000ml Methanol

MBD Quick Dry
0.03g MBD
15ml Acetone
40ml Methanol
15ml 2-Propanol
930ml Petroleum Ether

M-STAR (Methanol Soluble Triazine Amide Resin)

M-Star is a commercially prepared luminescent dye solution which may be excited by longwave ultra-violet light as well as the blue-green wavelengths of light. The commercially available solution of M-Star is extremely flammable; therefore, proper precautions should be taken when using M-Star. Currently M-Star is not suspected to be a carcinogen, but gloves should be worn to prevent contact with the skin. Adequate ventilation is required to prevent overexposure to the Methanol fumes.

The article to be processed is fumed with Superglue, examined and any visible latents are photographed. The M-Star is applied to the item by dipping or washing with a wash bottle. Allow 30 seconds to one minute for the M-Star to penetrate the Superglue. The article is then thoroughly rinsed with gently running tap water. Once the article is dry, it can then be examined with the CrimeScope.

RHODAMINE 6G

Rhodamine 6G has been the work horse of the dye staining techniques since 1973. Perhaps the most frequently used solution has been a 0.1% Rhodamine 6G in Methanol. However, as Menzel points out, a less concentrated solution of Rhodamine 6G (10^{-5} molar solution) works extremely well while also dispensing with the need for the sometimes detrimental Methanol rinse.

The article is treated with Rhodamine 6G by using a wash bottle or dipping. The article must be subsequently rinsed with Methanol. It may take multiple rinsing to remove the excess dye.

With the Rhodamine 6G Quick Dry and the Low Concentration Rhodamine 6G, the solution is applied using a wash bottle or dipping. However, the Methanol rinse is not needed. When the article is dry, it may be examined using the CrimeScope.

Note: The solvents used to prepare the Rhodamine 6G solution are extremely flammable and due caution must be exercised when preparing and using the solution. Since Rhodamine 6G poses a potential cancer hazard, protective gloves and lab coat should be worn when using the solutions. Whenever possible, a fume hood should be used to prevent contamination.

Rhodamine 6G (0.1%)
1g Rhodamine 6G
1000ml Methanol

Rhodamine 6G (no rinse)
Low Concentration
Stock solution:
0.48g Rhodamine 6G
1000ml Methanol
Working solution:
10ml stock
1000ml Methanol

Rhodamine 6G (Quick Dry)
Stock solution:
1g Rhodamine 6G
1000ml Methanol
Working solution:
5ml stock
25ml Acetone
15ml Acetonitrile
25ml Methanol
50ml 2-Propanol
880ml Petroleum Ether

RAM (Rhodamine/Ardrox/MBD)

RAM was developed by the FBI's Latent Fingerprint Section Research Team. It combines three highly luminescent dyes into one common working solution. RAM may be excited by wavelengths of light ranging from 250 nm to 530 nm. Overfuming the article with Superglue will cause excessive luminescence of the background when the article is treated with RAM. RAM may be applied by dipping or wash with a wash bottle. Dipping generally gives the best results. The article should be allowed to dry avoiding accumulation of the dye, which may otherwise form fluorescent spotting. Rinsing the article with gently running tap water will reduce much of the background and fluorescence spotting.

Rhodamine 6G Stock
100mg Rhodamine 6G

RAM Working Solution
Combine the following in order listed:

100ml Methanol

MBD Stock
100mg MBD
100ml Acetone

3ml Rhodomine 6G Stock
2ml Ardrox P133D
7ml MBD Stock
20ml Methanol
10ml 2-Propanol
8ml Acetonitrile
950ml Petroleum Ether

Saffranine O

Soffranine O has been recommended os an effective dye in the Manual of Fingerprint Development Techniques.
Its solvent is methanol and, therefore, a greater fire risk is present. Dip or wash the Superglued orticle in the dye solution. Allow the dye to penetrote for one minute. Gently rinse the article with cold running tap water. Allow to dry and examining the article with the CrimeScope.

Saffranine O (Methanol)
4g Saffranine O
1000ml Methanol

ANNEX C:

FLUORESCENT DYE STAINING TECHNIQUES USING ARDROX'S P-133D

By John Olenik

During the past decade, methods for fingerprint detection have changed dramatically. This is partly due to the discovery of fuming of latent fingerprints with cyanoacrylates (Super Glue) and the unique ability of cyanoacrylate developed prints to be receptive to certain chemical dyes, and these dyes able to enhance and capture faint latent prints.

This technology centers around properly fuming with cyanoacrylates. This is still a problem with many U.S. law enforcement agencies. There are now dozens of different techniques utilizing cyanoacrylates, from vacuum chambers to heat generators. These techniques all have their merits and limitations. Information on several inexpensive techniques will be given.

In recent years, numerous dyes have been developed for the enhancement of cyanoacrylate developed prints. Two dyes, that do not require a laser, but do require high intensity lights at certain wavelengths perform as well as laser dyes. One is called Ardrox's P-133D, it is an industrial dye penetrant and requires a longwave UV light source for visualization. Another popular dye is called Basic Yellow 40 (also called Panacryl Brilliant Flavine 10 GFF) and is excited by wavelengths in the blue region. These two are mentioned because they are relatively inexpensive and easily prepared. Several formulations will be given for their use.

Another relatively new dye concept is the blending of three different dyes, so that three different excitation wavelengths are covered. This allows the examiner to find an excitation wavelength where the background fluorescence is at a minimum, and this increases the contrast of the developed latent print making it easier to photograph.

The proper procedure before any of the techniques are used, is to give the evidence a visual exam with a bright white light source. The CrimeScope, in its white light mode, makes an excellent search tool and an excellent light for photography. After dye staining, sometimes due to background contamination or other interference, a second dye staining technique may result in a more enhanced latent print. This is where an alternate light source capable of using different wavelengths, will enhance prints to their maximum contrast. Technology is still changing, new dyes are still being developed and will

definitely require an alternate light source that has continuous tunability and a high power output from the UV to the Infrared region.

FLUORESCENT DYE STAINING TECHNIQUES USING ARDROX'S P-133D:

1. Fume evidence with cyanoacrylate vapors (Super Glue). Especially receptive are plastic bags (clear or colored), plastic coin trays and most metal surfaces (guns, etc.) being caretul not to over fume.
2. Dip, spray or swab the dye staining solution on the surface.
3. Allow to set until no solvent odor is present, approximately 30 seconds to one minute.
4. Rinse item under running tap water for approximately 30 seconds to one minute.
5. It tap water has high mineral content, give surface a quick rinse with distilled water (I use a plant spray bottle).
6. Air dry item or accelerate with hair dryer.
7. Examine under longwave UV light source.
8. Photograph any usable prints.
9. If no usable latent prints are apparent and the dye adheres to the background, rinse surface with an alcohol wash and re-examine.
If dye has been removed, re-dye stain after thoroughly dried.
If dye is still adhering to background, rinse a second time using alcohol saturated cotton balls, wiping the surface. Re-dye stain, if necessary.

DYE FORMULAS

A.
1ml Ardrox's P-133D
5ml Acetonitrile
95ml Freon TF

B.
1ml Ardrox's P-133D
5 ml Acetonitrile
95ml Alcohol
(Isopropanol or denatured Ethanol)

C.
1ml Ardrox's P-133D
9ml Isopropanol
40ml MEK (Methylethyl Ketone)
50ml water
Shake vigorously before applying to surface (recommend spray bottle).

D.
Three dye blend (RAB) tormula
0.4g Basic Yellow 40
10ml Acetic acid
0.04g Rhodamine 6-G
4ml Ardrox P-133D
40ml Acetonitrile
350ml Alcohol
(Isopropanol or denatured Ethanol)

ANNEX D:

PRINT GLO FLUORESCENT MAGNETIC FINGERPRINT POWDER

By John Olenik

1. It can be used as a conventional black magnetic fingerprint powder on surfaces that are not receptive to conventional fingerprint brushes, such as freshly handled glossy magazine pages, textured surfaces, finished leather products, etc. Once processed, the ridge characteristics appear almost black in color. At this point good latent prints can be lifted with conventional fingerprint tape, it the surface is relatively smooth.

2. On textured surfaces where the ridge detail is good and cannot be lifted, the resulting detail can be easily photographed, using a good white light source and using either high contrast film or conventional roll film. Excellent contrast will result either on a light colored background or a dark colored background, due to the unique color of the powder.

3. On surfaces where the ridge detail is obscured by a similar colored background, for example multicolored magazine papers, the ridge detail can be excited by a longwave UV lamp and the resulting ridge detail will become a bright yellow in color. The yellow image can be captured photographically either by use of black and white color film.

4. If the background fluorescence interferes with the yellow fluorescence of a developed print, an alternate light source can be used to excite the latent print at higher wavelengths and the resulting print will fluoresce orange or red depending upon the barrier filter used in front of the eyes or camera lens.

5. If a faintly developed print does not exhibit sufficient detail, the resulting image can also be enhanced by use of an infrared light source and infrared film. One of the components in the fluorescent magnetic powder has infrared absorbing properties.

Note: Print Glo is not a replacement for black magnetic fingerprint powder. It works best in situations where black magnetic fingerprint powder is too sensitive and coats the background surface.

ANNEX E:

LATENT PRINT EXAMINATION OF SKIN

By Ed German

Because the same chemicals naturally deposited in latent prints are also present on the rest of the body's skin, successful latent print detection on skin normally involves a contaminant of some type (blood, dirt, lipstick, wet paint, vaseline, etc.). I recommend that detectives look carefully at the victim's skin for any obvious "finger or palm ridge detail" (not just red marks on the skin). Success may come in the form of just having your evidence technicians take pictures of visible prints.

If the victim is wearing red or orange lipstick and the suspect put his hand on her (or his) mouth, you will have very good potential for examining the live (or deceased) victim's body (and clothing, bed sheets, etc.) with an alternate light source or portable laser (viewing through AR goggles - typically orange) to see latent prints which are invisible in room light/daylight but glow brightly when excited with relatively monochromatic blue-green light. Red and orange lipstick contain dyes very similar to those we use in crime labs to "tag" faintly developed super glue fumed prints and make them glow brightly.

Two schools of thought for developing latent (invisible) prints

There are two schools of thought insofar as how to develop (latent) invisible latent prints that may be on a body. They are the "lift transfer" method and "direct super glue fuming" method. It is possible to use both methods (lift transfer, then fuming) on cadavers, though most experts tend to use only one or the other.

Lift transfer method:
Known for decades as the "iodine fuming silver transfer lift" method, the development of fatty/waxy contaminant latent prints transferred from skin onto a nonporous surface is still quite popular... but now with improved transfer mediums and post-transfer development. Since the 1990's, super glue development of the transferred prints has generally replaced old fashioned exposure of silver plates to actinic lighting for developing impressions. Latent Print Examiner William Sampson from Florida has contributed to much of the modified transfer lift research for skin.
For live victims, a piece of black plastic (such as RC photo paper developed as black) can be held against areas suspected as possibly bearing latent (invisible)

prints. Other nonporous surfaces such as a mirror, glass, or metal plate may be used instead of photo paper. Some examiners use a sponge or soft pad between their hand and the photo paper fo improve contact the victim's skin.
Hold the transfer surface against the skin for 15 to 20 seconds. The nonporous transfer surface should then be super glue fumed to develop latent prints that may have transferred. There is no need to wait for "water content drying" because any water in the latent print residue will aid polymerization with super glue fumes.
After super glue fuming, further development of the nonporous transfer surface should include luminescent dye stain, laser or alternate lighf source excitation, and (lastly) powder rubbing.
For deceased victims, the body's skin surface should be between 72 and 80 degrees for opfimal fatty/waxy impression transfer. Warm the lift card or other transfer medium wifh a portable hair dryer just before liffing (warming it to above 86 degrees fahrenheit has been suggested by some researchers).
Some examiners use porous whife paper (such as adding machine tape) for lifting impressions. The main difference being the post-transfer development mefhods. DFO, ninhydrin and then PD is one of the most sensitive sequences for processing paper.

Super glue fuming cadavers:
Ivan Futrell and Tim Trozzi of the FBI's Latent Fingerprint Section worked with Art Bohanan of the Knoxville, Tennessee Police Department in performing some of the most significant research of the 1990's on super glue fuming bodies.
Ideally fhe body should not be refrigerated prior to fuming because moisfure can destroy impressions that might otherwise be developed. If already refrigerated, permit all condensation moisture to evaporate upon removing the body from fhe cold locker/drawer.
An airtight plastic tent can be assembled over the body and fuming is accomplished using heat acceleration (coffee cup warmers) accompanied by a small, battery powered fan to help with even fume distribution. The fan should be battery powdered because sparks from a 110V electric fan motor may pose a fire hazard in a confined fuming chamber.
A test strip of plastic or aluminum bearing a "test" latent print should always be fumed wifh the body. If the test impression has developed well (clearly) then you are ready fo dust the body using a contrasting color powder. Feather dusters with fluorescent powders are sometimes successful; buf black magnetic powder is used more often. Black magnetic powder usually "painfs" the skin less, doesn't require a laser or alternate light source and is easier to photograph.
Porfable fuming devices are commercially available and can be used to develop prints in as little as 10 to 15 seconds of fuming for each small area examined.

ANNEX F:

PROCESSING GUIDE FOR DEVELOPPING LATENT PRINTS

By Timothy A. Trozzi, Rebecca L. Schwartz, Mitchell L. Hollars

U.S. Department of Justice
Federal Bureau of Investigation
Laboratory Division

Processing Guide for Developing Latent Prints

Revised 2000

Processing Guide for Developing Latent Prints (2000)

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Table of Contents

Introduction

The identification of latent print evidence is often key in solving a crime. A latent print results from the reproduction of friction ridges found on parts of the fingers, hands, and feet. These prints consist of a combination of different chemicals that originate from natural secretions, blood, and contaminants. Natural secretions mainly derive from the eccrine and sebaceous glands and contain known chemical components. Eccrine gland secretions from the fingers, hands, and feet are both organic and inorganic, but only organic materials are secreted from the sebaceous glands. Other contaminants found in prints result from contact with different materials in the environment. Latent prints can be found on all types of surfaces. In general, surfaces can be characterized as porous, nonporous, or semiporous. Understanding these characteristics will aid in processing an item for latent prints.

The beginning of this manual is a list of processes and procedures for different surface types. Also included are processing sequences that specifically involve prints that are left in blood. Following these lists are details for each process that is currently implemented in the Latent Print Unit (LPU) of the Federal Bureau of Investigation (FBI) Laboratory.

Safety

The reader is advised to follow safe work practices when handling the chemicals used in latent print development. Safe work practices include the use of personal protective equipment (e.g., gloves, laboratory coats, eye protection), engineering controls (e.g., ventilation hoods), and hygiene practices (e.g., washing hands, no eating or drinking).

The reader assumes the responsibility of obtaining the necessary knowledge concerning each chemical used, the hazard(s) it may pose, and the procedures and work practices necessary to prevent unhealthful exposure. This information is available from the **Material Safety Data Sheets (MSDS)** and the labels affixed to the chemicals.

The Federal Bureau of Investigation is not responsible for the actions of any personnel outside the FBI using this guide with regard to the handling, use, or improper disposal of the chemicals listed.

Laboratory Chemicals and Equipment

The following **reagent grade** chemicals are used commonly in the latent print processing techniques described in this manual:

Acetone
Ethanol
Ethyl acetate
Glacial acetic acid
Isopropyl alcohol
Methanol
Petroleum ether

Acetonitrile is **HPLC grade**.

Below is a complete list of the laboratory equipment needed for the techniques described in this manual.

Bottles — clear and dark storage bottles; squirt bottles or sprayer
Brushes — air, camel-hair, fiberglass filament, and other brushes
Cotton
Dishes — aluminum, ceramic, and petri or other shallow dishes
Feather duster
Filter paper
Fume hood
Fuming chamber
Glassware — beakers and graduated cylinders of various sizes; glass dishes and trays
Heat gun
Heater or other heat source
Humidity chamber or humidified environment
Laser or alternate light source, including ultraviolet light
Magna brush wand
Magnetic stirrer and stirring rod or other stirring device
Orbital shaker
Oven
Paper towels
Plastic bottles or containers

Refrigerator with freezer
Scales
Steam iron
Tissues
Vacuum metal deposition chamber

Weights, Measures, and Temperature

kiloliter	kL	1 kL = 1000 L
liter	L	1 L = 1000 mL
milliliter	mL	1 mL = 0.001 L
kilogram	kg	1 kg = 1000 g
gram	g	1 g = 1000 mg
milligram	mg	1 mg = 0.001 g
gallon	gal	1 gal = 4 qt = 3.785 L
quart	qt	1 qt = 2 pt = 0.946 L
pint	pt	1 pt = 473.176 mL
atmosphere	atm	1 atm = 760 torr ≅ 14.7 pounds per square inch (psi)
teaspoon	tsp	

Converting from Fahrenheit (°F) to Celsius (°C)

$t_C = 5/9\ (t_F - 32)$

Converting from Celsius (°C) to Fahrenheit (°F)

$t_F = 9/5\ t_C + 32$

Processes and Procedures Used to Develop Latent Prints

Proper Sequences and Types of Processes for Porous, Nonporous, and Some *Unique* and/or Difficult Surfaces

Adherence to correct processing techniques increases the probability of developing the best quality latent prints. Adherence to the listed sequences ensures the best opportunity to develop all latent prints on an object and minimizes the chance of destroying latent prints.

Surfaces on which latent prints are deposited can be divided into two basic categories—porous and nonporous. Listed below are the suggested sequential processes for porous, nonporous, semiporous, and some unique and/or difficult surfaces.

Depending on the circumstances, all of the suggested processes will not always be performed. This is left to the discretion of the examiner.

Porous Surfaces

1. Visual
2. Inherent fluorescence by laser or alternate light source*
3. Iodine fuming
4. DFO (1,8-Diazafluoren-9-one)
5. Laser or alternate light source
6. Ninhydrin
7. Physical developer

* Alternate light source includes ultraviolet (UV) light

Nonporous Surfaces

1. Visual
2. Inherent fluorescence by laser or alternate light source
3. Cyanoacrylate fuming
4. Laser or alternate light source
5. Cyanoacrylate dye
6. Laser or alternate light source
7. Vacuum metal deposition (VMD)

8. Powder

Bloodstained Specimens—Porous

1. Visual
2. Inherent fluorescence by laser or alternate light source
3. DFO (1,8-Diazafluoren-9-one)
4. Laser or alternate light source
5. Ninhydrin
6. Diaminobenzidine (DAB); if not available, use amido black
7. Physical developer

Bloodstained Specimens—Nonporous

1. Visual
2. Inherent fluorescence by laser or alternate light source
3. Diaminobenzidine (DAB), if not available, use leucocrystal violet (LCV) or amido black
4. Cyanoacrylate fuming
5. Laser or alternate light source
6. Cyanoacrylate dye
7. Laser or alternate light source
8. Vacuum metal deposition (VMD)
9. Powder

Cardboard

1. Visual
2. Inherent fluorescence by laser or alternate light source
3. DFO (1,8-Diazafluoren-9-one)
4. Laser or alternate light source
5. Ninhydrin
6. Silver nitrate

Rubber Gloves—Semiporous

1. Visual
2. Inherent fluorescence by laser or alternate light source
3. Iodine spray reagent
4. Cyanoacrylate fuming
5. Laser or alternate light source
6. Magnetic powder
7. Cyanoacrylate dye
8. Laser or alternate light source
9. Ninhydrin
10. Distilled water rinse
11. Physical developer

When processing the nonadhesive side of tape, the integrity of the adhesive side should not be compromised by contact with cyanoacrylate dyes or other solvents. Acetate or some other substrate should be used to protect the adhesive side.

Tape—Nonadhesive Side

1. Visual
2. Inherent fluorescence by laser or alternate light source
3. Cyanoacrylate fuming
4. Laser or alternate light source
5. Cyanoacrylate dye
6. Laser or alternate light source
7. Vacuum metal deposition (VMD)
8. Powder

Tape—Adhesive Side

Light-colored adhesive side of tape

1. Visual
2. Inherent fluorescence by laser or alternate light source

3. Sticky-side powder; alternate black powder; ash gray powder; gentian violet

4. Laser or alternate light source

Dark-colored adhesive side of tape

1. Visual

2. Inherent fluorescence by laser or alternate light source

3. Ash gray powder; Liqui-Drox*; gentian violet

4. Laser or alternate light source

* Cyanoacrylate fuming must be done on the nonadhesive side of tape, then both sides can be processed with Liqui-Drox.

Wallpaper

1. Visual

2. Inherent fluorescence by laser or alternate light source

3. Iodine spray reagent

4. Ninhydrin

5. Silver nitrate

Photographs—Emulsion Side

1. Visual

2. Inherent fluorescence by laser or alternate light source

3. Iodine spray reagent

4. Cyanoacrylate fuming

5. Laser or alternate light source

6. Cyanoacrylate dye

7. Laser or alternate light source

8. Vacuum metal deposition (VMD)

9. Powder

Photographs—Paper Side—Semiporous

1. Visual

2. Inherent fluorescence by laser or alternate light source

3. Cyanoacrylate fuming
4. Laser or alternate light source
5. Magnetic powder
6. DFO (1,8-Diazafluoren-9-one)
7. Laser or alternate light source
8. Ninhydrin
9. Cyanoacrylate dye
10. Laser or alternate light source
11. Physical developer

Glossy Paper—Semiporous

1. Visual
2. Inherent fluorescence by laser or alternate light source
3. Cyanoacrylate fuming
4. Laser or alternate light source
5. Magnetic powder
6. DFO (1,8-Diazafluoren-9-one)
7. Laser or alternate light source
8. Ninhydrin
9. Cyanoacrylate dye
10. Laser or alternate light source
11. Physical developer

Selection of Processes

In addition to the type of surface, another determining factor in choosing the proper process is the residue of the latent print, including perspiration, blood, oil or grease, and dust.

The condition of the surface also contributes to determining the correct processes. Such surface characteristics include dryness, wetness, dirtiness, and tackiness or stickiness.